

Federal Motor Carrier Safety Administration
Office of Analysis, Research and Technology

Smart Infrared Inspection System

Preliminary Field Test Results

Thursday, November 12, 2009

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FMCSA Technology Division





Agenda

- ◆ Overview of the Smart Infra-Red Inspection System
- ◆ System Details & User Interface
- ◆ Field Test Description
- ◆ Preliminary Field Test Results
- ◆ State Enforcement Feedback
- ◆ Questions

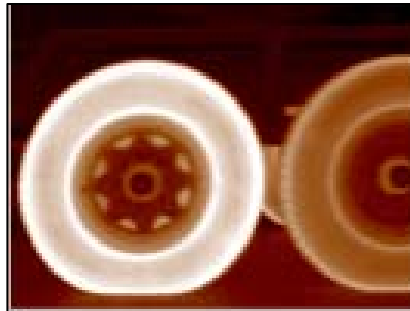
Smart Infrared Inspection System (SIRIS)

- ◆ Grant for a demonstration of thermal imaging technologies
 - Identify, in real time, faults and failures in tires, brakes and bearings mounted on commercial motor vehicles
 - Employ system along the interstate
 - Explore whether statistical tools can be developed that can predict impending tire, brake, or bearing failures



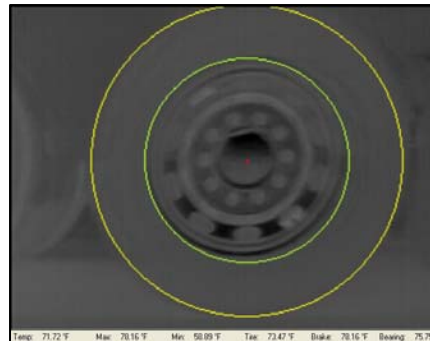
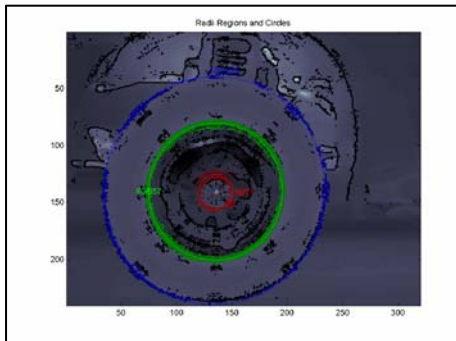
SIRIS – Details

- ◆ \$1.4 M Research Grant
- ◆ 3-year Project
- ◆ Grant competitively awarded September 2006 to IEM, Inc. of Troy, NY
- ◆ Supplemental \$500K from NYSERDA for improved high speed performance



SIRIS – Concept of Operations

- ◆ Measure wheel temperatures on passing vehicles
- ◆ Segment wheels into areas of interest
- ◆ Automatically flag those meeting certain criteria
- ◆ Alert inspectors when vehicle is flagged



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SIRIS – Field Tests and Demonstrations

- ◆ Early prototype demonstrated Summer 2007
- ◆ Field data collection in New York and New Jersey during 2008
- ◆ Demonstrated in Spring 2009
- ◆ Conducted Operational Test in Summer 2009
- ◆ To be installed at Greene County Weigh Station later this year

SIRIS User Interface

- ◆ System triggers on wheel ends and looks at both sides of the vehicle
- ◆ System looks at three areas specifically:
 - Tire
 - Wheel (brake area)
 - Hub
- ◆ *Automatically* evaluates each vehicle and alerts when problem noted
- ◆ Vehicles currently identified by image during inspection
- ◆ Currently works at speeds up to about 20 mph



Current SIRIS User Interface

(this vehicle placed OOS)

Operational Test Essentials

- ◆ Location: Greene County Weigh Station; part of FMCSA Roadside Technology Corridor
- ◆ Dates: July 23 through August 5, 2009
- ◆ Support: Tennessee Department of Safety and Tennessee Department of Transportation

Operational Test Procedures

- ◆ All vehicles diverted to pass SIRIS
- ◆ Speed limited to 10 mph though actual speed past system closer to 20 mph
- ◆ SIRIS sounded audible alert when it flagged a vehicle
- ◆ Report printed and handed to inspector
- ◆ All Brake flags subject to Performance-Based Brake Tester (PBBT) and Level 1 Inspection
- ◆ All Tire and Bearing flags subject to Level 2 Inspection

Test Protocols – Brake Flags

- ◆ Flags based on algorithm that compares relative temperatures of all segmented “brake regions” on vehicle
- ◆ Considers following factors:
 - Temperature variability between all wheels
 - Temperature relative to ambient temperature
 - Temperature relative to other wheel on same axle

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Test Protocols – Tire and Bearing Flags

◆ Tire Flags

- Flag based on tire temperatures relative to others on same vehicle and ambient temperature

◆ Bearing Flags

- Flag based on bearing temperature relative to ambient temperature for each wheel

SIRIS Video

Preliminary Results

Total Vehicles Scanned by SIRIS	4,373
Total Vehicles Automatically Flagged by SIRIS (%)	359 (8.2%)
Flagged for Brakes	328
Flagged for Tires	29
Flagged for Bearings	2
Total Vehicles Subject to Vehicle Inspection	305
Total Vehicles Placed OOS for Reason Directly Related to SIRIS Flag	193 (63.3%)
Total with Any Flaw Found (includes both OOS and others flaws not meeting OOS criteria)	234 (76.7%)

Inspection Results

Type of Flaw Detected	Inspections	OOS	Related Issue or Violation	No Violation
Brakes	274	174 (63.5%)	33 (12.0%)	67 (24.5%)
Tires	29	18 (62.1%)	8 (27.6%)	3 10.3%)
Bearings	2	1 (50.0%)	0	1 (50.0%)
Total	305	193 (63.3%)	41 (13.4%)	71 (23.3%)

Brake Results

◆ Types of Brake Flaws Detected (Data from Level 1 Inspection Reports)

● Brake Adjustment	118 Vehicles	236 Wheels
● Brake Failure	116 Vehicles	1,145 Wheels
● Inoperative Brakes	45 Vehicles	110 Wheels
● Inadequate Brake Lining	32 Vehicles	53 Wheels
● Brake Connection Leak	23 Vehicles	86 Wheels
● Cracked Pads	14 Vehicles	26 Wheels
● Cracked Lining	13 Vehicles	23 Wheels
● Air Chamber/Air Leak	13 Vehicles	18 Wheels
● Other Issues	64 Vehicles	110 Wheels
(each <10 Vehicles/Wheels)		

Note: Total exceeds number of vehicles inspected due to multiple violations on same vehicle

Tire Results

- ◆ Hot tires correlated with 'gators' on highways
- ◆ Vehicles flagged for "Hot Tire" subject to Level 2 Inspection
- ◆ Pressure gauged first in 'flagged' tire; then inner tire
- ◆ If no problem found, gauged tires on opposite side of axle
- ◆ Air bag checked
- ◆ Problems detected included:
 - Underinflated and flat tires
 - Tire tread
 - Deflated air bag

Bearing Results

- ◆ Overheated bearings associated with variety of dangerous conditions
- ◆ Vehicles flagged for “Hot Bearing” subject to Level 2 Inspection
- ◆ Hand-held IR thermometer used to gauge bearing temperature and checked
- ◆ Only 2 vehicles flagged during Operational Test; one found to have oil leak in wheel bearing

State Enforcement Feedback

Lieutenant James McKenzie



THP District 5 Scale House – Greene County
Located on I-81 South, Mile Marker 21
P.O. Box 310
Mosheim, TN 37818

SIRIS Next Steps: Research Grant

- ◆ Complete analysis of field test results
- ◆ Refine rules to reduce flags and increase OOS rate
- ◆ Publish findings in Final Report
 - Summary of all work
 - Data from tests
 - UMTRI analytical report
- ◆ Install the system along the FMCSA CMV Roadside Technology Corridor in partnership with the Tennessee Department of Safety/Tennessee Highway Patrol (THP)

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SIRIS Next Steps: Follow-on Activities

- ◆ Conduct follow-on testing to further refine system
- ◆ Integrate SIRIS into THP roadside activities
- ◆ Develop and publish performance specifications
- ◆ Support technology transfer and deployment efforts in other interested States

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